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Appl. No. 10/687,242

Amendt. Dated Monday, Feb. 12, 2007

Reply to Office Action of Sept. 11, 2002

REMARKS / ARGUMENTS

In response to the First Office Action of September 11, 2006, Applicants have amended the application to resolve concerns raised by the Examiner. Reconsideration and allowance of the specification and pending, amended claims are respectfully requested.

I. Invention Overview

The invention is a fuel cell stack that includes a reaction portion having an end cell secured adjacent to a current collector. The collector has a sensible heat no greater than a sensible heat of the end cell, that is less than 1.0 mm thick (as amended), and an electrical resistivity no greater than 100 micro-ohms centimeters. An insulator is secured adjacent the collector and has a thermal conductivity that is no greater than 0.100 Watts per meter per degree Kelvin and that is less than 20 mm thick (as amended). Because of the low sensible heat of the current collector and low rate of heat transfer of the insulator compared to the heat generation of the end cell, heat does not readily leave the end cell resulting in a rapid heating of the end cell. This avoids freezing and accumulation of product water in the end cell during start up in subfreezing ambient conditions.

II. Response to Office Action

This Response will address the concerns of the Examiner in the order in which they appear in the September 11, 2006 First Office Action. First at Section one the Examiner objected to

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claim 22 because of typographical error. By this amendment that error had been corrected.

Next at Section 2, the Examiner has rejected claims 1, 6, and 11 - 14 under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,764,786 to Morrow et al. (hereafter "Morrow") as evidenced by a "ZIRCAR" disclosure on Alumina Insulation. In particular, the Examiner correlates elements of those claims with various aspects of Morrow. However, by the present amendment claim 1 has been amended to further limit the claimed current collector to be "no greater than 1.00 millimeter thick", and to further limit the claimed insulator to have a "thickness of less than 20 millimeters". (Antecedent basis for the amendment to limit the current collector to being no greater than 1.00 millimeter thick is found in original claim 16, now canceled. Antecedent basis for the amendment to limit the insulator to having a thickness of less than 20 millimeters is found in original claim 7, now canceled.)

Nothing in Morrow discloses specific thickness limits on either a current collector or an insulator. Therefore, because Morrow does not show each and every element as set forth in now amended independent claim 1 either expressly or inherently, Morrow cannot anticipate independent claim 1 as amended. (See Manual of Patent Examining Procedure ("M.P.E.P."), Section 2131.)

By the present Amendment/Response, all of the pending independent claims, claims 1, 22, 25, have also been amended to further distinguish the thermal conductivity of the insulator.

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By the amended claims, a "thermal conductivity across the insulator is no greater than 0.100 Watts per meter per degree Kelvin...", where the original conductivity was "no greater than 0.500 Watts per meter degree Kelvin". (Antecedent basis for this amendment to the thermal conductivity of the insulator is found in the range of thermal conductivities of the insulator found between the original thermal conductivity limits of the insulator claimed in original claim 1 (0.500 Watts per meter degree Kelvin) and original claim 4 (0.005 Watts per meter degree Kelvin).)

This amendment to the thermal conductivity of the insulator removes the claim limits from a range of thermal conductivities disclosed in the "ZIRCAR" reference cited by the Examiner at Section 3 of the First Office Action. Consequently, it is respectfully urged that independent claim 1 as now amended is not anticipated by Morrow as evidenced by ZIRCAR. Therefore, it is requested that the Examiner remove the 35 U.S.C. 102(e) rejection of claim 1. Because dependent claims 6, 11 - 14 further narrow independent claim 1, it is similarly requested that the Examiner also remove the Section 102(e) rejection of claims 6, 11 - 14 described in Sections 4 - 8 of the First Office Action.

Next, at Sections 9 - 13, the Examiner has rejected claims 2 - 5, 7 - 10 and 16 - 20 under 35 U.S.C. 102(e) as anticipated by or in the alternative, under 35 U.S.C. 103(a) as being unpatentable over Morrow. In particular, the Examiner rejected claims 2 - 3 and 16 - 20 reviewing various aspects of Morrow dealing with the current collector in Section 12 of the Office

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Action, concluding: "It would have been obvious to one having ordinary skill in the art at the time the invention was made to draw the conclusion that thickness of current collectors could vary with a propensity to choose thinner ones." Similarly the Examiner rejected claims 4 - 5 and 7 - 10 reviewing portions of Morrow dealing with the insulator in Section 13 of the Office Action, concluding: "It would have been obvious to one having ordinary skill in the art at the time the invention was made to come to the conclusion that varying insulator thickness also alters the properties that are dependent upon it."

While the thickness of the current collector and insulator are important parameters in the Applicants' claimed invention, it is respectfully pointed out that the claims 2 - 5, 7 - 10 and 16 - 20 require a more significant element that is neither shown nor suggested in Morrow. Those claims depend from independent claim 1, and claim 1 requires that "the current collector (30) [have] a sensible heat less than a sensible heat of the end cell (12)..." Similarly, claim 1 also requires that "a total rate of heat transfer across the insulator (40) from the end cell (12) is no greater than heat generated by the end cell (12)..."

Nothing in Morrow shows or suggests that the current collector include a quality, namely - sensible heat, that must be less than the sensible heat of the end cell. Similarly, and perhaps more importantly, nothing in Morrow requires that the insulator include qualities so that a total rate of heat transfer across the insulator from the end cell is no greater than heat generated by the end cell. While Morrow may disclose components having characteristics that decrease heat loss from

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an end cell, the primary goal of Morrow was to produce a lightweight, inexpensive pressure plate and current collector, which resulted in a lower thermal mass primarily because of the non-metallic, non-conductive, fiber-reinforced composite material making up the pressure plate, as well as the dense, light, non-porous electrically conductive graphite current collector. (See, Morrow, at Col. 7, line 66 - Col. 8, line 15.)

In contrast, the present claimed invention seeks to resolve a more specific problem, namely preventing "water in the water transport plates [from remaining] frozen [during a 'bootstrap start-up'] thereby preventing removal of product water, which results in the end cells being flooded with fuel cell product water. The flooding of the end cells retards reactant fluids from reaching the catalysts and may result in a negative voltage in the end cells. The negative voltage in the end cells may result in hydrogen gas evolution at the cathode electrode and/or corrosion of carbon support layers of electrodes of the cell. Such occurrences would degrade the performance and long-term stability of the fuel cell stack." (See, specification at page 3, lines 4 - 14.) The present claimed invention discloses a unique way to solve this specific concern. The solution requires that the current collector and the insulator are constructed with properties that are a direct function of both the sensible heat of the end cell and also of the heat generated by the end cell.

While using "thinner" current collectors, or "varying thickness" of the insulator for desirable properties as suggested by the Examiner may reduce the problem, the claimed

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invention of the present application requires not just thinner current collectors or insulators. Instead, prior to manufacturing and/or selecting the current collector and insulator of the present claimed invention, the sensible heat of the end cell and the total heat generated by the end cell must be determined. Only then can an acceptable current collector and insulator be utilized in the claimed fuel cell stack.

For example, in an exemplary fuel cell stack inspired by Morrow, one could employ a thinner current collector and a thinner insulator than those shown or suggested in Morrow. However, the exemplary fuel cell stack could nonetheless have an end cell with a capacity to generate so much heat that the heat rapidly moves through the current collector and insulator resulting in substantially delayed heating of the end cell and the deleterious flooding of the end cell that dramatically degrades short and long term fuel cell stack performance. In contrast, the claimed fuel cell stack of the present invention would not suffer such deleterious results with a high heat generating end cell. That is because both the current collector and the insulator must necessarily be constructed as a function of both the sensible heat and the heat generated by the specific end cell utilized within the fuel cell stack in which the current collector and insulator are to be utilized.

Accordingly, because nothing in Morrow shows or suggests a current collector or an insulator having properties that are a direct function of the properties of the end cell of Morrow, it is respectfully requested that Morrow be removed as a reference under 35 U.S.C. 103. For the reasons recited above, it is also

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urged that Morrow does not include all of the elements of independent claim 1, and hence its dependent claims 2 - 5, 7 - 10 and 16 - 20. Therefore it is also urged that claims 2 - 5, 7 - 10 and 16 - 20 are not anticipated under 35 U.S.C. 102(e). Consequently it is requested that the Examiner remove the rejections of claims 2 - 5, 7 - 10 and 16 - 20 because they are neither anticipated by nor unpatentable over Morrow.

Next, at Sections 14 - 19, the Examiner has rejected claims 15 and 21 - 25 under 35 U.S.C. 103(a). In particular, at Sections 15 - 17 the Examiner has rejected claims 15 and 21 under 35 U.S.C. 103(a) as being unpatentable over Morrow. Because these claims depend from claim 1, and because it is urged for the reasons recited above that claim 1, as amended, is now non-obvious and allowable, it is urged as well that claims 15 and 21 are now allowable. "If an independent claim is non-obvious, then any claim depending therefrom is nonobvious." (M.P.E.P., Sec. 2143.03.) Moreover, because as argued above, Morrow does not show or suggest critical claimed elements of independent claim 1, as amended, it is urged that Morrow be removed as a reference for these claims 15 and 21, and that the be allowed for this separate reason.

At Section 18, the Examiner has rejected independent claim 22, and its dependent claims 23, 24 under 35 U.S.C. 103(a) as being unpatentable over Morrow in view of U.S. Published Patent Application 2003/0124414A1 to Hertel et al. It is noted that by the present Amendment, claim 22 has been amended as described above to distinguish it over Morrow with respect to the assertions presented by the Examiner in Sections 1 - 13 under 35

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U.S.C. 102(e). Moreover, to further clarify the distinctions of the claimed invention of independent claim 22 over Morrow for the purposes of this Section 103(a) rejection, a limitation found in claim 1 has been amended into independent claim 22, namely that the insulator be: "secured to the current collector so that a total rate of heat transfer across the insulator (40) from the end cell (12) is no greater than heat generated by the end cell (12)..." (Antecedent basis for this amendment of claim 21 is found in original claim 1, and elsewhere in the claims and specification.) As recited above, Morrow simply does not show or suggest such a limitation. There is nothing in Morrow that requires use of an insulator that restricts heat transfer across the insulator as a function of heat generated by the end cell. Therefore, it is respectfully requested that Morrow be removed as a reference for independent claim 22, and that it and its dependent claims 23 and 24 be allowed. As recited above, the dependent claims simply narrow the now allowable independent claim 22 and are hence allowable. And, separately, Morrow should also be removed as a reference against claims 23 and 24 for reasons discussed above.

Next, at Section 19 of the Office Action, the Examiner has rejected independent claim 25 under 35 U.S.C. 103(a) as being unpatentable over Morrow in view of U.S. Patent 6,048,635 to Guthrie et al. It is noted that for purposes of clarity independent claim 25 has been amended to distinguish it over Morrow under the Examiner's 35 U.S.C. 102(e) rejections of claim 1 by including the distinguishing limitations of the thickness of the current collector and the insulator and the thermal conductivity of the insulator. Independent claim 25 also

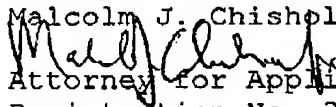
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includes the other limitations discussed above that the current collector must have a sensible heat less than the sensible heat of the end cell, and that the insulator must be secured to the current collector so that a total rate of heat transfer across the insulator is no greater than heat generated by the end cell. Because nothing in Morrow shows or suggests either of these two limitations, it is respectfully requested that Morrow be removed as a reference in rejecting claim 25 as amended, and that independent claim 25 be allowed.

III. Conclusion

By the present amendments to claims 1, 22 and 25, and by the argument presented above it is respectfully urged that all of the Examiner's concerns raised in the First Office Action have been resolved. Accordingly, it is respectfully requested that the Examiner remove the rejections of the pending claims, and issue a Notice of Allowance.

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